Bicicleta pública y su impacto en la salud

Dr. David Rojas-Rueda

Centro de Investigación en Epidemiología Ambiental

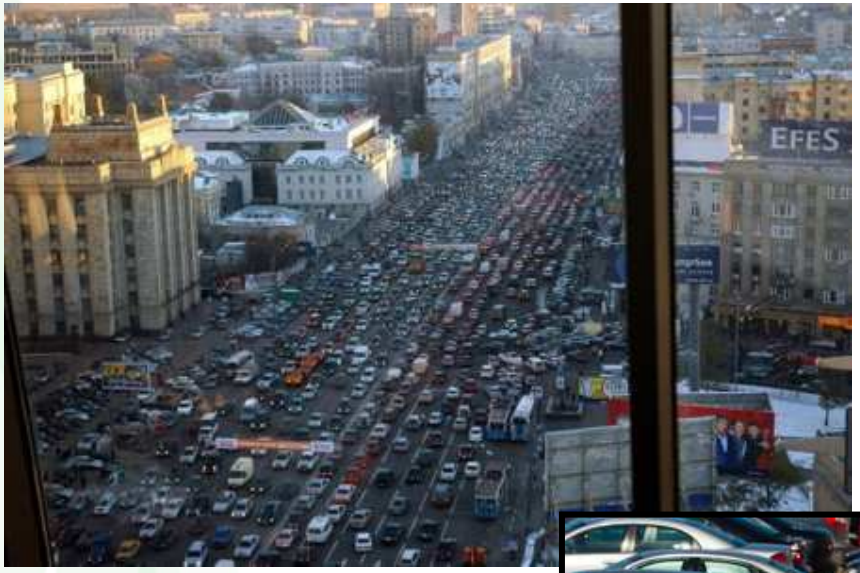
Accidentes de trafico

Contaminación del aire

Transporte y Salud.

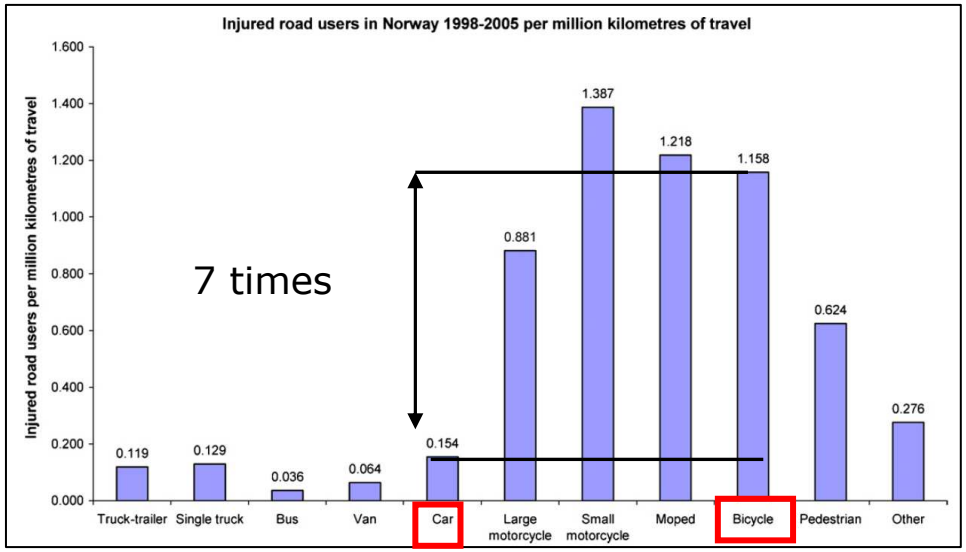
Actividad Física

Sistema de Bicicletas Públicas

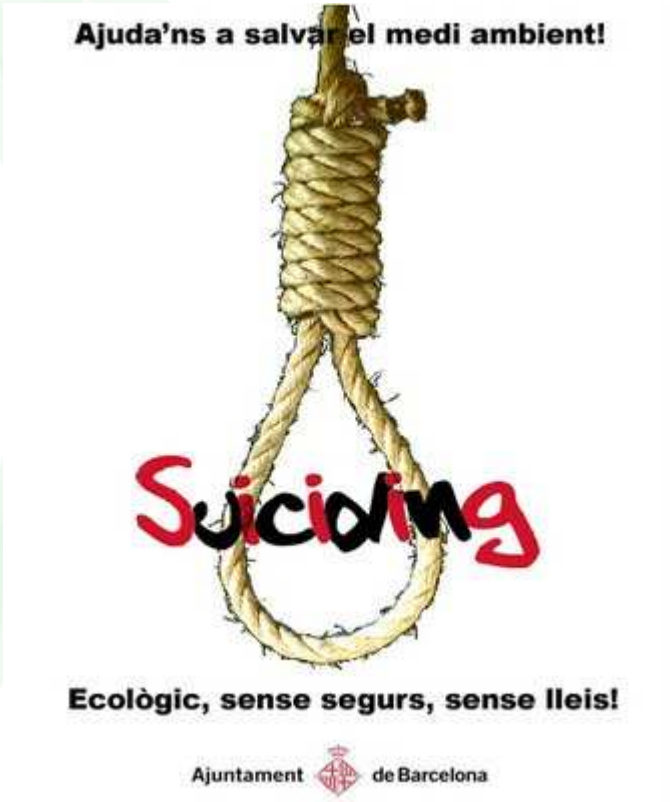


Riesgos para la salud

	Minute ventilation (m^3/hr) [a]
Sleep	0.27
Rest	0.61
Car	0.61
Cycle	2.22



Jacobsen PL. Safety in numbers: more walkers and bicyclists, safer walking and bicycling. Inj Prev 9:205-209 (2003).


Ajuda'ns a salvar el medi ambient!
Suicidi
Ecològic, sense segurs, sense lleis!
Ajuntament de Barcelona


¡?

BMJ

BMJ 2011;343:d4521 doi: 10.1136/bmj.d4521

The health risks and benefits of cycling in urban environments compared with car use: health impact assessment study

David Rojas-Rueda
Audrey de Nazelle
Marko Tainio
Mark J Nieuwenhuijsen

tapas ACTIVE TRANSPORTATION HEALTH IMPACT ASSESSMENT

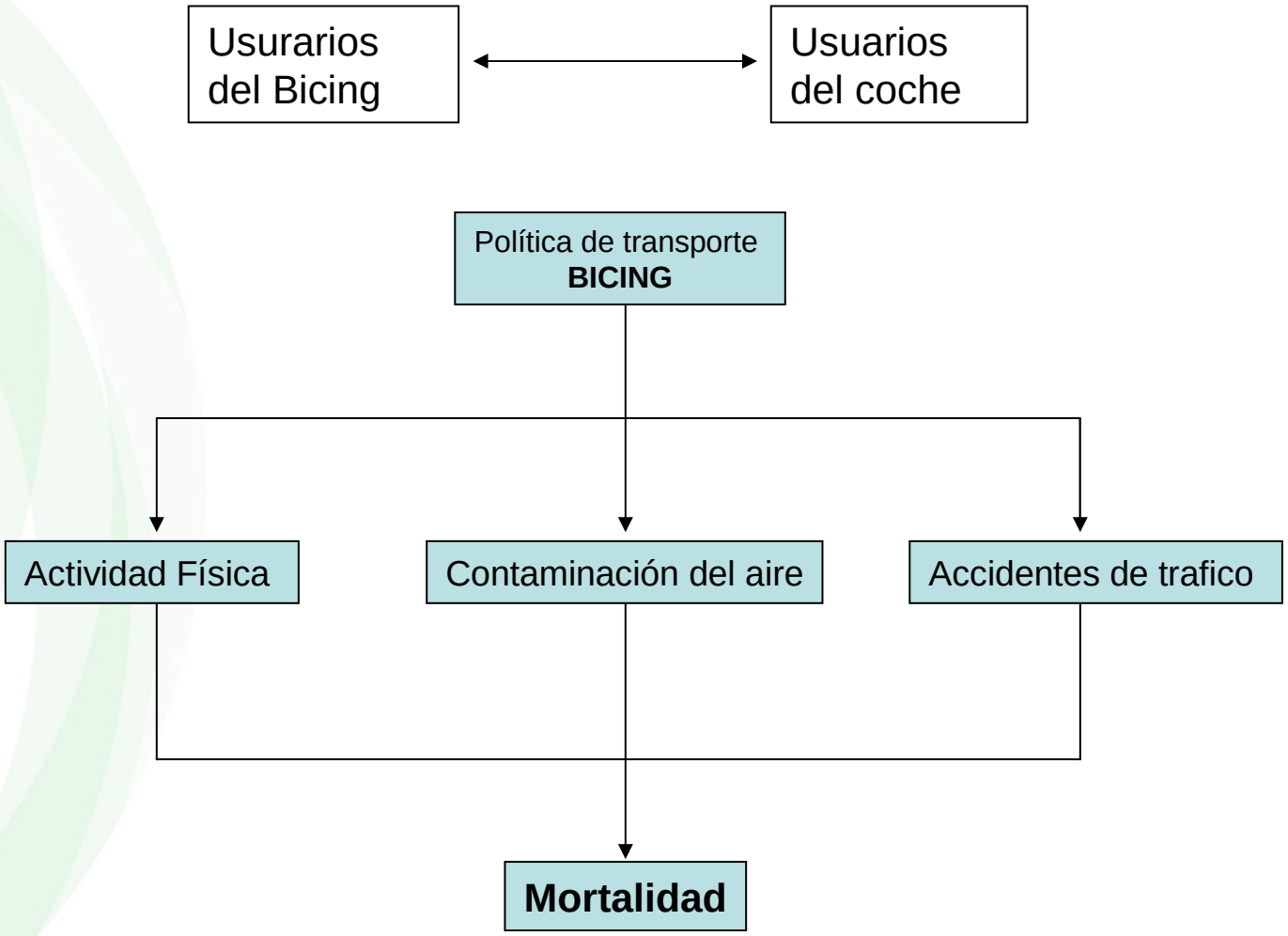
CREAL

Generalitat de Catalunya

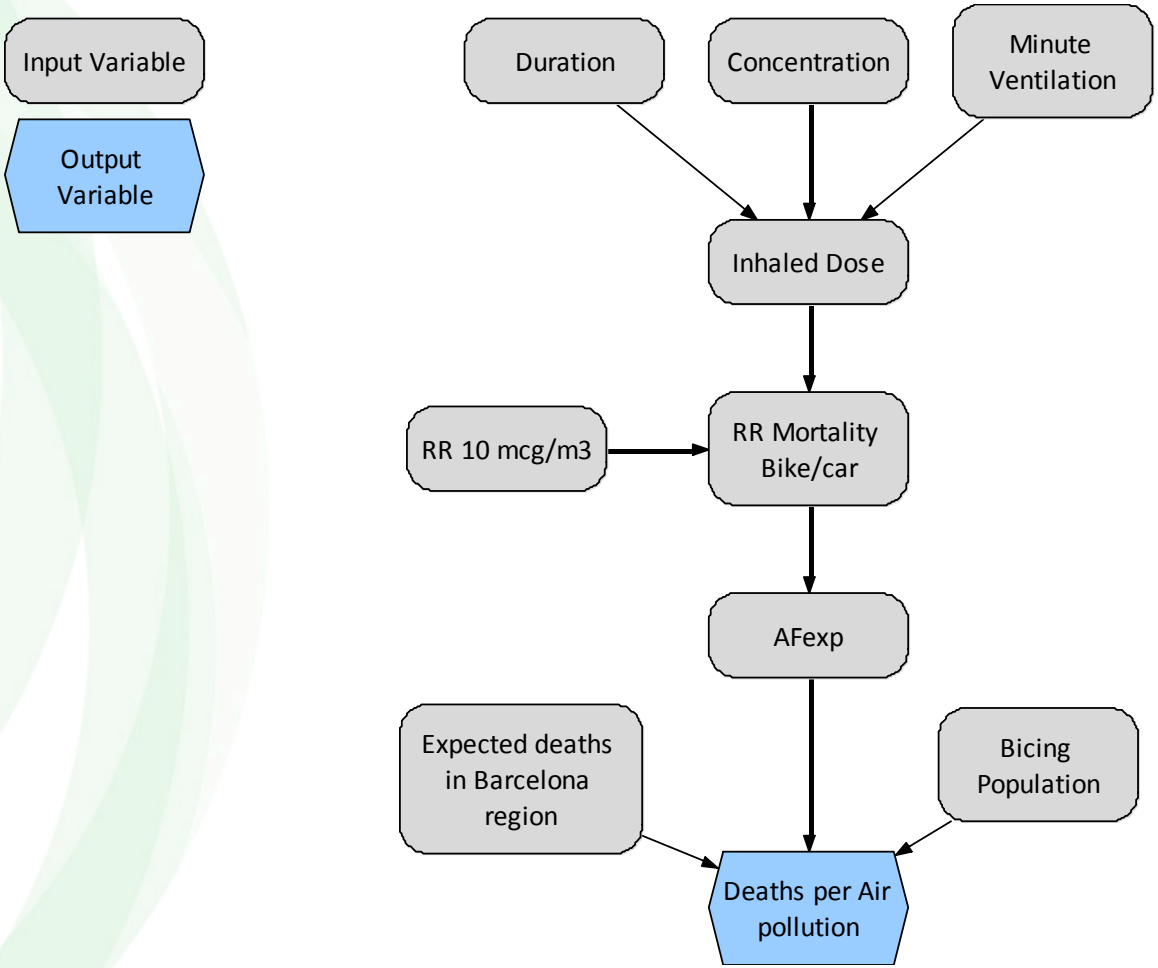
Parc de Salut Barcelona MAR

UNIVERSITAT POMPEU FABRA

Evaluación de Impactos en Salud



Contaminación del aire



RR: Relative Risk of all-cause mortality.
RR10: average adjusted relative risk of all-caused mortality for a 10µg/m3 change of pollutant.
AFexp: Attributable fraction among exposed; BCN: Barcelona;

Contaminación del aire

	Concentration (µg/m^3)	
	PM2.5*	BS*
Sleep	19	1.7
Rest	19	1.7
Car	46.2	18
Cycle	29.5	8.3

*PM2.5: Particulate matter les than 2.5 micrometer; BS: Black Smoke.
a Minute ventilation in bike is calculated using a random population distribution and algorithms developed by the EPA (Johnson 2002; de Nazelle et al. 2009) from average METs measured for [Bike, car, rest] = [6, 2, 1]. Uncertainty based on data.
b Should add the left time of transport (0.79 in case of car or more 0.65 in case of cycling).
c The data presented are the data of the 219 days that are considered to be travelling; the relative risks, attributable fractions and expected deaths are weighted by the 365 days a year.

Contaminación del aire

	Concentration (µg/m^3)		Minute ventilation (m^3/hr) [a]
	PM2.5*	BS*	
Sleep	19	1.7	0.27
Rest	19	1.7	0.61
Car	46.2	18	0.61
Cycle	29.5	8.3	2.22

*PM2.5: Particulate matter les than 2.5 micrometer; BS: Black Smoke.
a Minute ventilation in bike is calculated using a random population distribution and algorithms developed by the EPA (Johnson 2002; de Nazelle et al. 2009) from average METs measured for [Bike, car, rest] = [6, 2, 1]. Uncertainty based on data.
b Should add the left time of transport (0.79 in case of car or more 0.65 in case of cycling).
c The data presented are the data of the 219 days that are considered to be travelling; the relative risks, attributable fractions and expected deaths are weighted by the 365 days a year.

Contaminación del aire

	Concentration (µg/m^3)		Minute ventilation (m^3/hr) [a]	Activity duration (hrs)
	PM2.5*	BS*		
Sleep	19	1.7	0.27	8
Rest	19	1.7	0.61	15 [b]
Car	46.2	18	0.61	0.21
Cycle	29.5	8.3	2.22	0.35

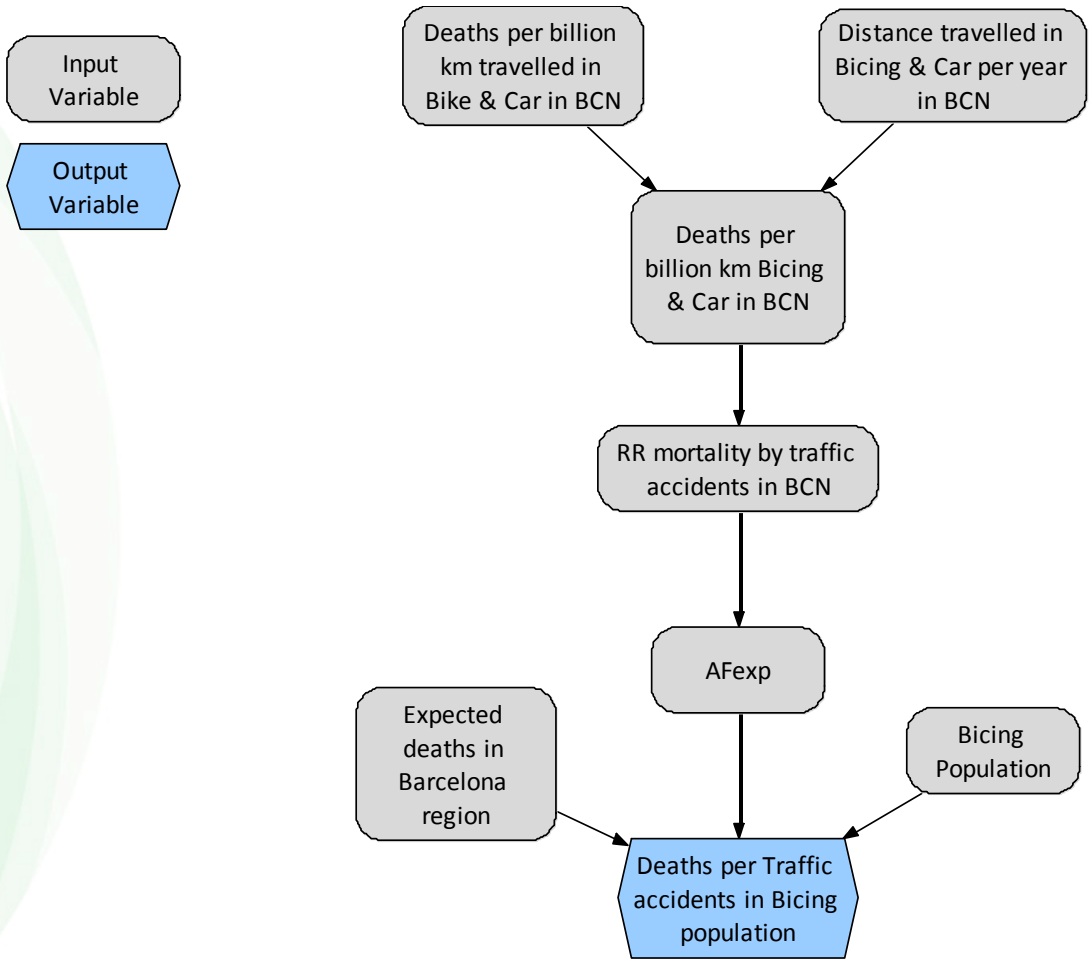
*PM2.5: Particulate matter les than 2.5 micrometer; BS: Black Smoke.
a Minute ventilation in bike is calculated using a random population distribution and algorithms developed by the EPA (Johnson 2002; de Nazelle et al. 2009) from average METs measured for [Bike, car, rest] = [6, 2, 1]. Uncertainty based on data.
b Should add the left time of transport (0.79 in case of car or more 0.65 in case of cycling).
c The data presented are the data of the 219 days that are considered to be travelling; the relative risks, attributable fractions and expected deaths are weighted by the 365 days a year.

Contaminación del aire

	Concentration (µg/m^3)		Minute ventilation (m^3/hr) [a]	Activity duration (hrs)	Inhaled Dose (µg/day) [c]		Total Dose (µg/day) [c]	
	PM2.5*	BS*			PM2.5	BS	PM2.5*	BS*
Sleep	19	1.7	0.27	8	41	3.6		
Rest	19	1.7	0.61	15 [b]	173	15.5		
Car	46.2	18	0.61	0.21	5.9	2.3	237	22
Cycle	29.5	8.3	2.22	0.35	23	6.4	245	24

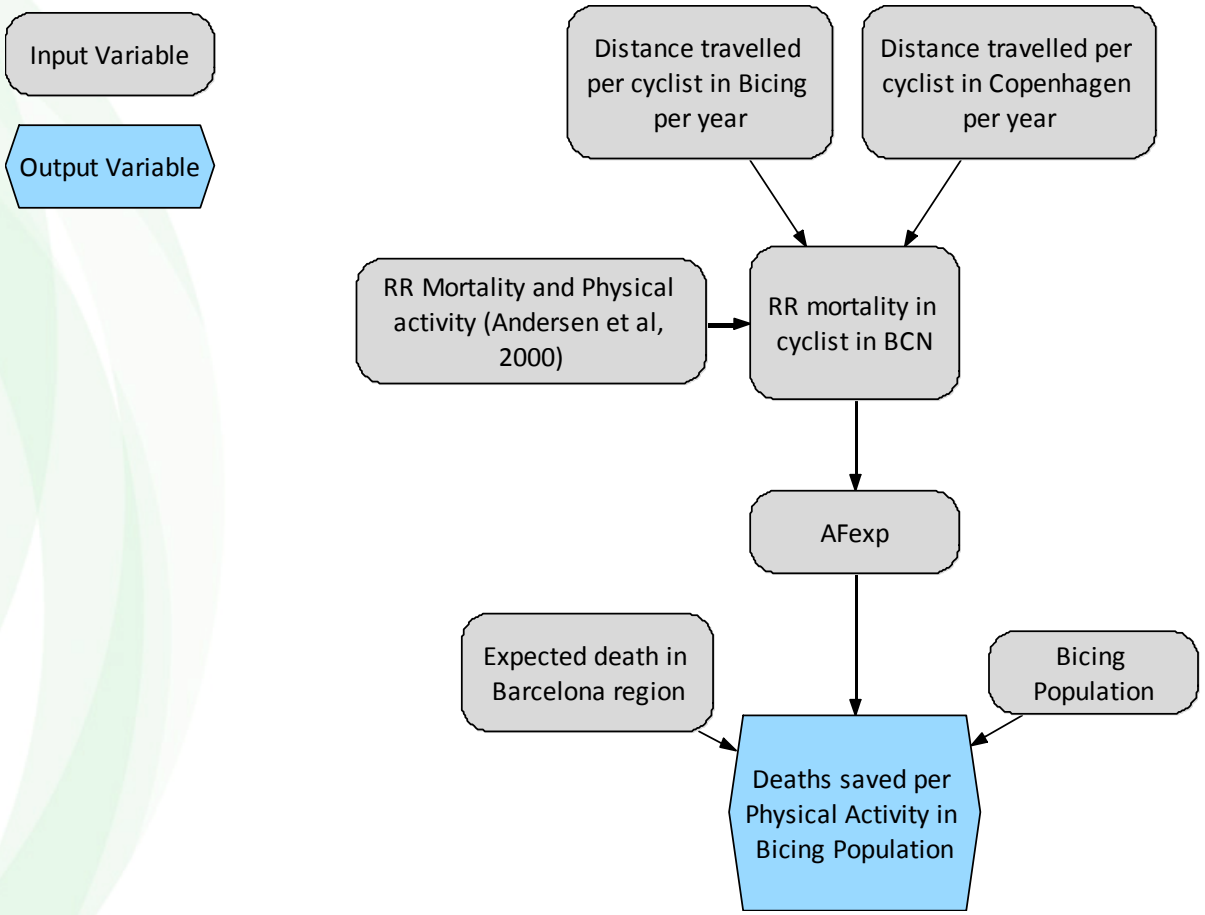
*PM2.5: Particulate matter les than 2.5 micrometer; BS: Black Smoke.
a Minute ventilation in bike is calculated using a random population distribution and algorithms developed by the EPA (Johnson 2002; de Nazelle et al. 2009) from average METs measured for [Bike, car, rest] = [6, 2, 1]. Uncertainty based on data.
b Should add the left time of transport (0.79 in case of car or more 0.65 in case of cycling).
c The data presented are the data of the 219 days that are considered to be travelling; the relative risks, attributable fractions and expected deaths are weighted by the 365 days a year.

Accidentes de trafico



RR: Relative Risk of all-cause mortality.
AFexp: Attributable fraction among exposed; BCN: Barcelona;

Actividad Física



RR: Relative Risk of all-cause mortality.
AFexp: Attributable fraction among exposed; BCN: Barcelona;

Resultados

Mortalidad			
	RR[a]	**AF_{exp} [b]**	**Muertes / año**
Accidentes de Trafico	1.0007	0.0007	0.03
Contaminación del Aire PM2.5	1.002	0.002	0.13
Actividad física	0.80	-0.23	-12.46
Total			**-12.28**

[a] RR: Relative Risk of death in bicycle vs car ; [b] AFexp: attributable fraction among exposed;
[c] According with € 1,500,000 for each life standard value of statistical life used across Europe (HEAT for cycling, WHO, 2008);
PM2.5: Particulate Matter les than 2.5mm; BS: Black Smoke;

Resultados con BS

Mortalidad			
	RR[a]	**AF_{exp} [b]**	**Muertes / año**
Accidentes de Trafico	1.0007	0.0007	0.03
Contaminación del aire			
BS	1.0009	0.0008	0.04
Actividad física	0.80	-0.23	-12.46
Total			**-12.37**

[a] RR: Relative Risk of death in bicycle vs car; [b] AFexp: attributable fraction among exposed;
[c] According with € 1,500,000 for each life standard value of statistical life used across Europe (HEAT for cycling, WHO, 2008);
PM2.5: Particulate Matter les than 2.5mm; BS: Black Smoke;

Costos económicos

	Euros [b]
Costo de inversión inicial en el sistema "Bicing"	15.9 millones
El costo anual de mantenimiento y gestión[a]	10.2 millones

[a] Bicing data in 2008;
[b] According with € 1,500,000 for each life standard value of statistical life used across Europe (HEAT for cycling, WHO, 2008);
[C] Bicing annual economic benefits for mortality.

Costos económicos

	Euros [b]	Beneficios en Salud [c]
Costo de inversión inicial en el sistema "Bicing"	15.9 millones	**18.4 millones**
El costo anual de mantenimiento y gestión[a]	10.2 millones	**18.4 millones**

[a] Bicing data in 2008;
[b] According with € 1,500,000 for each life standard value of statistical life used across Europe (HEAT for cycling, WHO, 2008);
[C] Bicing annual economic benefits for mortality.

Costos económicos

	Euros [b]	Beneficios en Salud [c]	Ahorro €
Costo de inversión inicial en el sistema "Bicing"	15.9 millones	**18.4 millones**	**2.5 millones**
El costo anual de mantenimiento y gestión[a]	10.2 millones	**18.4 millones**	**8.2 millones**

[a] Bicing data in 2008;
[b] According with € 1,500,000 for each life standard value of statistical life used across Europe (HEAT for cycling, WHO, 2008);
[C] Bicing annual economic benefits for mortality.

Costos económicos

	Euros [b]	Beneficios en Salud [c]	Ahorro €
Costo de inversión inicial en el sistema "Bicing"	15.9 millones	**18.4 millones**	**2.5 millones**
El costo anual de mantenimiento y gestión[a]	10.2 millones	**18.4 millones**	**8.2 millones**
Ingresos anuales del "Bicing" [a]	4.5 millones		

[a] Bicing data in 2008;
[b] According with € 1,500,000 for each life standard value of statistical life used across Europe (HEAT for cycling, WHO, 2008);
[C] Bicing annual economic benefits for mortality.

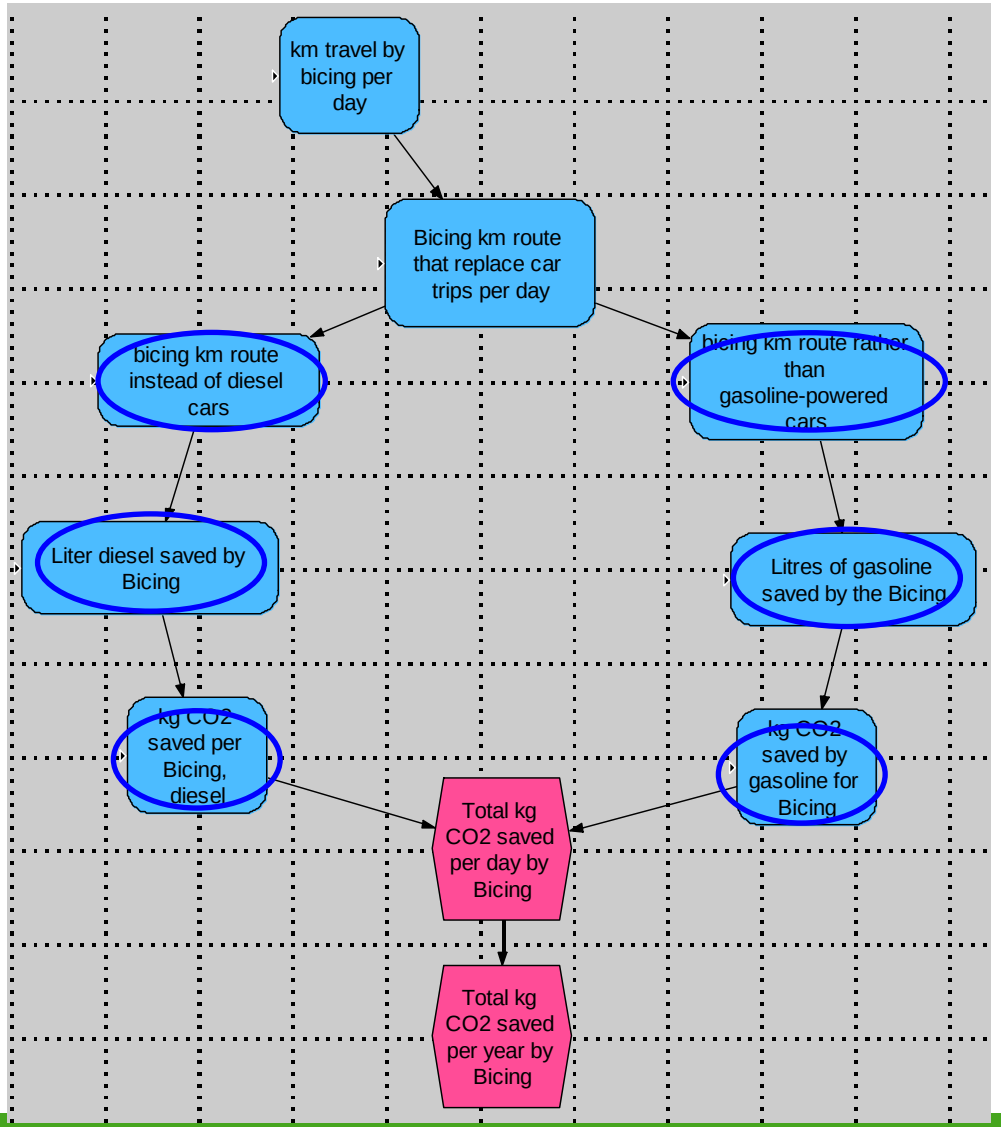
Emisiones de CO_2

Porcentaje de vehículos diesel y de gasolina

Eficiencia del combustible L / 100 km
(Diesel y gasolina)

Emisiones de CO_2 kg / L
(Diesel y gasolina)

9 millones kg/CO_2 en 2009



Resumen

- Los beneficios de la actividad física son mayores comparados con los riesgos de inhalar contaminación del aire y de sufrir un accidente de trafico.

- Hemos calculado una reducción potencial de las emisiones de CO_2, que representan el 0.9% de las emisiones de todos los vehículos motorizados de la ciudad de Barcelona en 2009.

- Es sistema provee de mayores beneficios económicos en salud que los gastos que implica el sistema.

- Es el primer estudio que evalúa múltiples riesgos y beneficios de una política implementada que promueve el ciclismo dentro de las áreas urbanas.

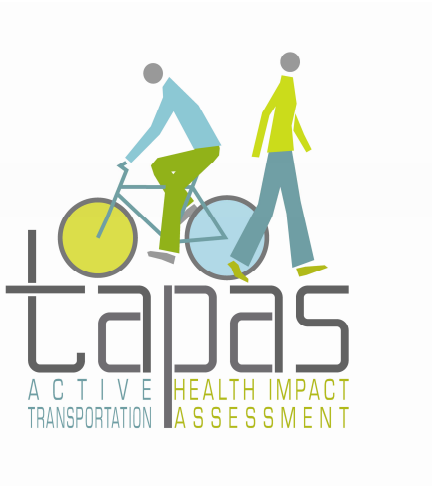
CREAL

Centre de Recerca en Epidemiologia Ambiental

Generalitat de Catalunya

Parc de Salut Barcelona MAR

UNIVERSITAT POMPEU FABRA



drojas@creal.cat

Escenarios de transporte

Table 9. Deaths saved in different shift mode scenarios

Mode of transport	RR[i]	AF exp[j]	Deaths saved per percentage of shift mode vs car*						Scenario without bike vs car*		Difference between scenarios [k]
			90%	70%	60%	50%	30%	10%			
Walk 2 km[a]	0,89	-0,12	-6,41	-4,99	-4,27	-3,56	**-2,14**	-0,71	60% PT 10 min[d]	**-2,55**	
Walk 4.9 km[b]	0,73	-0,37	-19,30	-15,01	-12,86	-10,72	-6,43	-2,14	10% Car	0	
Walk 6,2 km[c]	0,64	-0,57	-29,49	-22,94	-19,66	-16,38	-9,83	-3,28	30% Walk 2 km	**-2,14**	
PT 10min[d]	0,93	-0,07	-3,83	-2,98	**-2,55**	-2,13	-1,28	-0,43	**Total**	**-4,69**	
PT 5min[e]	0,97	-0,04	-1,85	-1,44	-1,23	-1,03	-0,62	-0,21			
									Scenario with bike vs car*		
Bike 2 km[f]	0,92	-0,09	-4,60	-3,58	-3,07	-2,56	**-1,53**	-0,51	60% Bike 6,2 km	**-11,67**	
Bike 4.9 km[g]	0,80	-0,23	-12,46	-10,14	-8,69	-7,25	-4,35	-1,45	10% Bike 6,2 km	**-1,95**	
Bike 6,2 km[h]	0,75	-0,34	-17,51	-13,62	**-11,67**	-9,73	-5,84	**-1,95**	30% Bike 2 km	**-1,53**	
									Total	**-15,15**	Total deaths saved
											10,46

* The car is de reference scenario, with RR=1; [a] people walk 2 km per day; [b] people walk 4.9 km per day; [c] people walk 6.2 km per day; [d] people walk 10 minutes per trip (1.25 km/day) when use public transport; [e] people walk 5 minutes per trip (0.62 km/day) when use public transport; [f] people cycling 2 km per day; [g] people cycling 4.9 km per day; [h]people cycling 6.2 km per day; [i] RR: relative risk (the RR reported for walk and public transport are adjust with the RR=0.78 used for the WHO-HEAT for walking; and the RR reported in bike are adjust for RR=0.72 used in WHO-HEAT for cycling); [j] AFexp: attributable fraction in exposure population; [k] Difference between scenario without bike vs scenario with bike.

Escenarios de transporte

Table 9. Deaths saved in different shift mode scenarios

Mode of transport	RR[i]	AF exp[j]	Deaths saved per percentage of shift mode vs car*						Scenario without bike vs car*		Difference between scenarios [k]
			90%	70%	60%	50%	30%	10%			
Walk 2 km[a]	0,89	-0,12	-6,41	-4,99	-4,27	-3,56	**-2,14**	-0,71	60% PT 10 min[d]	**-2,55**	
Walk 4.9 km[b]	0,73	-0,37	-19,30	-15,01	-12,86	-10,72	-6,43	-2,14	10% Car	0	
Walk 6,2 km[c]	0,64	-0,57	-29,49	-22,94	-19,66	-16,38	-9,83	-3,28	30% Walk 2 km	**-2,14**	
PT 10min[d]	0,93	-0,07	-3,83	-2,98	**-2,55**	-2,13	-1,28	-0,43	**Total**	**-4,69**	
PT 5min[e]	0,97	-0,04	-1,85	-1,44	-1,23	-1,03	-0,62	-0,21			
									Scenario with bike vs car*		
Bike 2 km[f]	0,92	-0,09	-4,60	-3,58	-3,07	-2,56	**-1,53**	-0,51	60% Bike 6,2 km	**-11,67**	
Bike 4.9 km[g]	0,80	-0,23	-12,46	-10,14	-8,69	-7,25	-4,35	-1,45	10% Bike 6,2 km	**-1,95**	
Bike 6,2 km[h]	0,75	-0,34	-17,51	-13,62	**-11,67**	-9,73	-5,84	**-1,95**	30% Bike 2 km	**-1,53**	
									Total	**-15,15**	Total deaths saved
											10,46

* The car is de reference scenario, with RR=1; [a] people walk 2 km per day; [b] people walk 4.9 km per day; [c] people walk 6.2 km per day; [d] people walk 10 minutes per trip (1.25 km/day) when use public transport; [e] people walk 5 minutes per trip (0.62 km/day) when use public transport; [f] people cycling 2 km per day; [g] people cycling 4.9 km per day; [h]people cycling 6.2 km per day; [i] RR: relative risk (the RR reported for walk and public transport are adjust with the RR=0.78 used for the WHO-HEAT for walking; and the RR reported in bike are adjust for RR=0.72 used in WHO-HEAT for cycling); [j] AFexp: attributable fraction in exposure population; [k] Difference between scenario without bike vs scenario with bike.

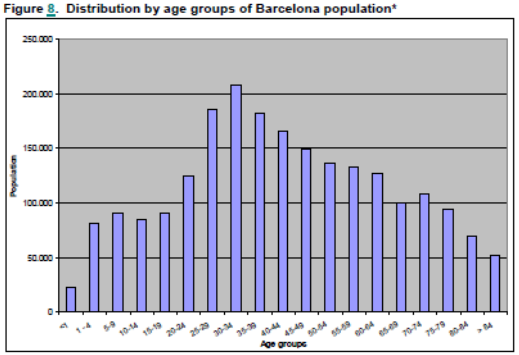
Escenarios por edad

Table 10. Bicing age scenarios

	Population distribution		
Age groups	BCN distribution (%)	Young scenario (%)	Older scenario (%)
15-19	6	13	1
20-24	8	15	3
25-29	12	16	5
30-34	14	14	7
35-39	12	12	9
40-44	11	10	11
45-49	10	8	13
50-54	9	6	15
55-59	9	4	17
60-64	8	2	19
Average age	39	33	48
AF exp	-0,23	-0,23	-0,23
Deaths expected [a]	52	31	86
Deaths saved [b]	12,46	7,4	20,5

*BCN: Barcelona; AF_{exp}: attributable fraction among exposed;
[a] Deaths expected in 25,426 persons with age distribution according for each scenario;
[b] Deaths saved related with physical activity vs car scenario.

Figure 8. Distribution by age groups of Barcelona population*



* Statistics and Information service, Catalan government 2007.

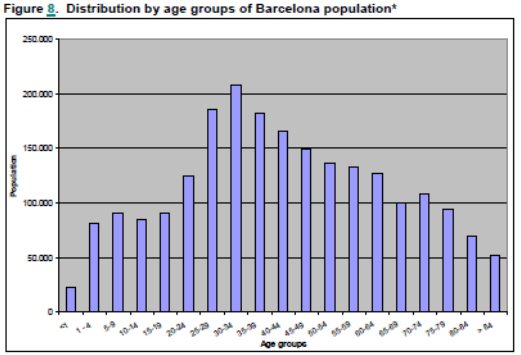
Escenarios por edad

Table 10. Bicing age scenarios

Age groups	Population distribution		
	BCN distribution (%)	Young scenario (%)	Older scenario (%)
15-19	6	13	1
20-24	8	15	3
25-29	12	16	5
30-34	14	14	7
35-39	12	12	9
40-44	11	10	11
45-49	10	8	13
50-54	9	6	15
55-59	9	4	17
60-64	8	2	19
Average age	39	33	48
AF exp	-0,23	-0,23	-0,23
Deaths expected [a]	52	31	86
Deaths saved [b]	12,46	7,4	20,5

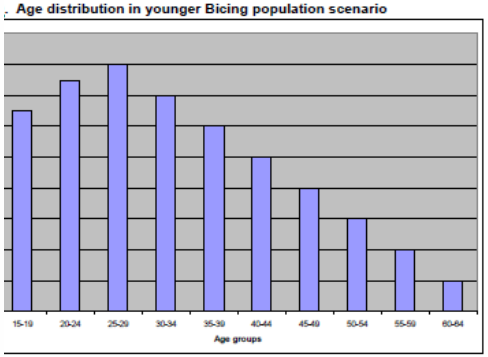
*BCN: Barcelona; AF_{exp}: attributable fraction among exposed;
[a] Deaths expected in 25,426 persons with age distribution according for each scenario;
[b] Deaths saved related with physical activity vs car scenario.

Figure 8. Distribution by age groups of Barcelona population*



* Statistics and Information service, Catalan government 2007.

Age distribution in younger Bicing population scenario



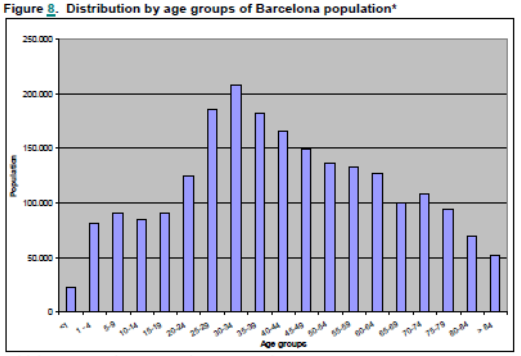
Escenarios por edad

Table 10. Bicing age scenarios

Age groups	Population distribution		
	BCN distribution (%)	Young scenario (%)	Older scenario (%)
15-19	6	13	1
20-24	8	15	3
25-29	12	16	5
30-34	14	14	7
35-39	12	12	9
40-44	11	10	11
45-49	10	8	13
50-54	9	6	15
55-59	9	4	17
60-64	8	2	19
Average age	39	33	48
AF exp	-0,23	-0,23	-0,23
Deaths expected [a]	52	31	86
Deaths saved [b]	12,46	7,4	20,5

*BCN: Barcelona; AF_{exp}: attributable fraction among exposed;
[a] Deaths expected in 25,426 persons with age distribution according for each scenario;
[b] Deaths saved related with physical activity vs car scenario.

Figure 8. Distribution by age groups of Barcelona population*



* Statistics and Information service, Catalan government 2007.

Age distribution in younger Bicing population scenario

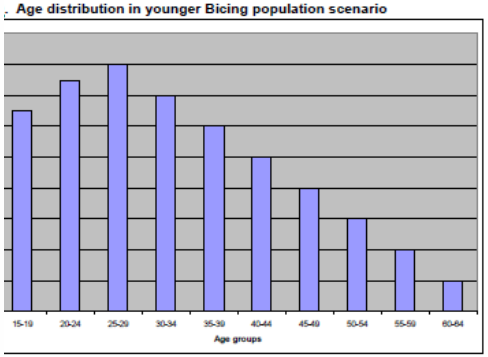


Figure 10. Age distribution in older Bicing population scenario